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ABSTRACT

This learning unit on using graphs is one in the Choice Series, a self-learning development program for supervisors. Purpose stated for the approximately eight-hour-long unit is to enable the supervisor to look at the usefulness of graphs in displaying figures, use graphs to compare sets of figures, identify trends and seasonal variations in graphs; and make forecasts of the future by using graphs. An introduction provides an overview of the unit and lists unit objectives. Parts A through C contain informative material, activities and answer keys, self-checks and answer keys, and a summary. Topics include drawing graphs, reading graphs, and forecasting with graphs. Part D contains performance checks--an end check to be completed alone and a tutor check and work-based project. Part E consists of a brief unit review, extensions (print sources of additional information, such as units or sections in books), and a list of references. (YLB)

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An Open Tech Project

SUPERVISING

TECHNICAL ASPECTS OF SUPERVISION

32: Using Graphs

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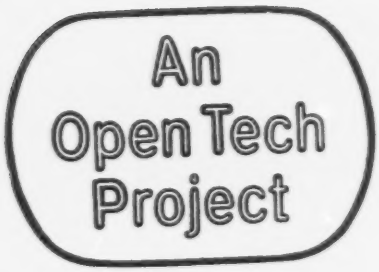
32: USING GRAPHS

Linda Carr



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Linda Carr
Using Graphs (Number 32 in the CHOICE SERIES of learning units)

Series Editor: Harry V Pardue
Northern Regional Management Centre.

WORKING GUIDE TO THIS UNIT IN YOUR DEVELOPMENT PROGRAMME

This Unit is now your personal property - it's not for handing back to your training officer or to a tutor. It is your working book.

The Contents will increase in value to you each time you write on one of its pages. This is a working text for your personal notes - without notes its value is limited.

Qualifications forget about certificates and diplomas - you don't need them for this programme. What you do need is the wish:-

* to do your job better
* for personal development

Your study time is really up to you - we guess you will need about 8 hours in total. But it's your time - spend as long as you like.

How am I doing? you can judge for yourself by checking out how well you cope with the tasks we call Activities and Self Checks which occur throughout the unit. You can also get the Tutor Check and/or the Work Based Project to your tutor for an unbiased view of your progress.

Work Pace it's really up to you and depends on your interest. However, if you do well on the Activities and Self Checks, you could afford to speed up a little. Of course, if you don't do as well as you expect then you could slow down a little or flick back into the unit for a quick review of the more difficult ideas.

When in doubt - ask or seek help from:

* your family and friends
* colleagues at work
* your company training staff
* other open learners
* your tutor, by phone, by a visit to your support centre or by dropping your tutor a line through the post.

Don't worry if what you learn doesn't seem to be of use to you now, remember that times change - it may be useful one day. Anyway, just knowing more improves personal confidence.

So now make a start:-

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32: USING GRAPHS by Linda Carr

ABOUT THIS UNIT

The supervisor's job often involves recording and collating figures relating to such things as work output, performance, attendance lateness.

This Unit is designed to help you to understand the figures you collect, and their importance to the job of supervision. It will help you to compare different sets of figures and draw useful conclusions from them.

- - -

IN THIS UNIT WE WILL:

* Look at the usefulness of graphs in displaying figures
* Use graphs to compare sets of figures
* Examine the circumstances in which graphs can mislead
* Make forecasts based on past records of figures

- - -

AUDIO TAPE Side 1

Before you continue through the unit, you should listen to side 1 of the audio tape that accompanies the unit. You will find it useful if you refer to the unit objectives shown below whilst you listen to the tape. You may wish to make the objectives clearer to yourself by making a note or two on the page as you listen.

OBJECTIVES

On completion of this unit you will be better able to:

* identify the most important features in set of figures
* make useful comparisons between two or more graphs
* identify trends and seasonal variations in graphs
* make forecasts of the future by using graphs

PART A DRAWING GRAPHS

1 Introduction

As a supervisor you will find that you are expected to record, look at, understand and take action on a lot of information which is in the form of figures. For example you may be expected to record output from machines every day, or you may receive a computer printout with numbers of employees absent each week. Information in the form of numbers will be referred to as DATA. We will start our work by looking at graphs to see what they can tell us.

2 Data

Let's look at data by starting with the data you come across at work.

ACTIVITY 1
Time guide
1 min

Jot down three examples of data which you come across at work.

* _____
* _____
* _____

Obviously the data you have included will depend on the type of work which you supervise. Here's some typical examples:

* numbers of your workteam who are late, absent or sick each week;
* daily output of clerical staff;
* errors made by clerical staff;
* daily output of production operators;
* wastage on machines.

Provided that what you have included can be measured numerically then it is an example of DATA.

For example:

5 people were late this week
3 people were off sick
1 typist typed 50 pages

EXTENSIONS 1 & 2
page 47

If you take up other Choice units in for example statistics or looking at figures you'll find examples of data at work, and ways of using it.

Let's look at a short case study - we'll see how supervisors get involved with data:

Bill was promoted to supervisor of Section 2 on January 1st and by the end of January had found the job involved all sorts of problems he had not previously thought about. In mid-February he came into the Manager's office, holding a computer printout, and with a worried look on his fact.

Jack: What's the problem Bill?

Bill: I've just got a computer return with sickness figures for the last six months. The January figure looks very high.

Jack: Let me have a look.

After pausing to look at the figures he said:

Jack: That's fine Bill, I'm not seriously worried about those figures.

Bill: But I don't understand.

Jack: OK, Bring me the printouts for the last 2 years . . .

ACTIVITY 2
Time guide
1 min

Here is the data Bill was looking at on the printout for the past six months.

SECTION 2 - No. of days sickness

Aug	Sept	Oct	Nov	Dec	Jan
26	20	32	35	39	53

Why was Bill looking worried?

* _____

The January figure of 53 looks very high compared with the previous five months' figures which vary between 20 and 39. It looked to Bill as though sickness figures had increased just when he took over.

Let's go on to examine why the manager was not so concerned about the sickness figure of 53 for January. To do this we need to look at the data for the past two years, which Bill was able to extract from the files.

To make the data clearer we will present the figures on a graph.

3

3. Drawing graphs

Let's first have a look at the data Bill was able to extract from the files on sickness for the last 2 years.

1982	J	F	M	A	M	J	J	A	S	O	N	D
	51	48	35	30	30	29	29	27	25	30	35	45
1983	J	F	M	A	M	J	J	A	S	O	N	D
	55	45	33	32	29	36	27	26	20	32	35	39
1984	J											
	53											

You will see that the last six months' figures are the same figures that we looked at in Activity 2. Now we have data for a longer period of time. However it is difficult to get a picture of how sickness figures are changing from data like this. Because tables of figures like this can look confusing, we often use other methods to display the data.

Let's try to get a clearer picture of this data by drawing a graph. I have started the graph below but don't try to complete the graph yet, we'll do this later. Let's just go through how we set about drawing the graph.

ABC Co.

ABSENCE DUE TO SICKNESS

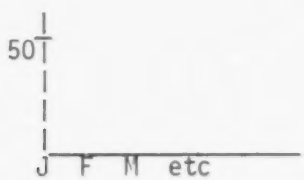
On the graph the numbers of days sickness are on the vertical line and the months are on the horizontal line.These two lines are usually called horizontal axis and vertical axis.

So how do we get our data onto these lines? Well, we make our lines into a scale - rather like a ruler or tape measure. You'll see that our horizontal line or axis has 36 marks on, one for each month of the years 1982, 1983 and 1984. Now we have a position reserved for the data in each month.

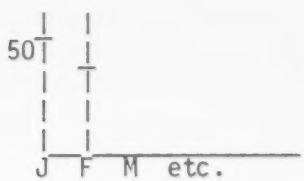
The other data we have is the absences - so this can go on the vertical line or axis. The lowest number we have is 20 (Sept '83) and the highest is 55 (Jan '83). But we should make some allowance for absences lower than 20 (let's choose zero) and for absences higher than 55 (let's choose 70). Now we can get all our present absences on our line and also get other numbers in as well.

So we now have 7 equal spaces up the vertical axis and each space represents 10 absences.

Let's take a look at how we put our numbers in. In January 1982 there were 51 absences, therefore we make a point where absences = 51 in the vertical line for January 1982.



In February the value is 48 - we therefore plot this on the vertical line for February.



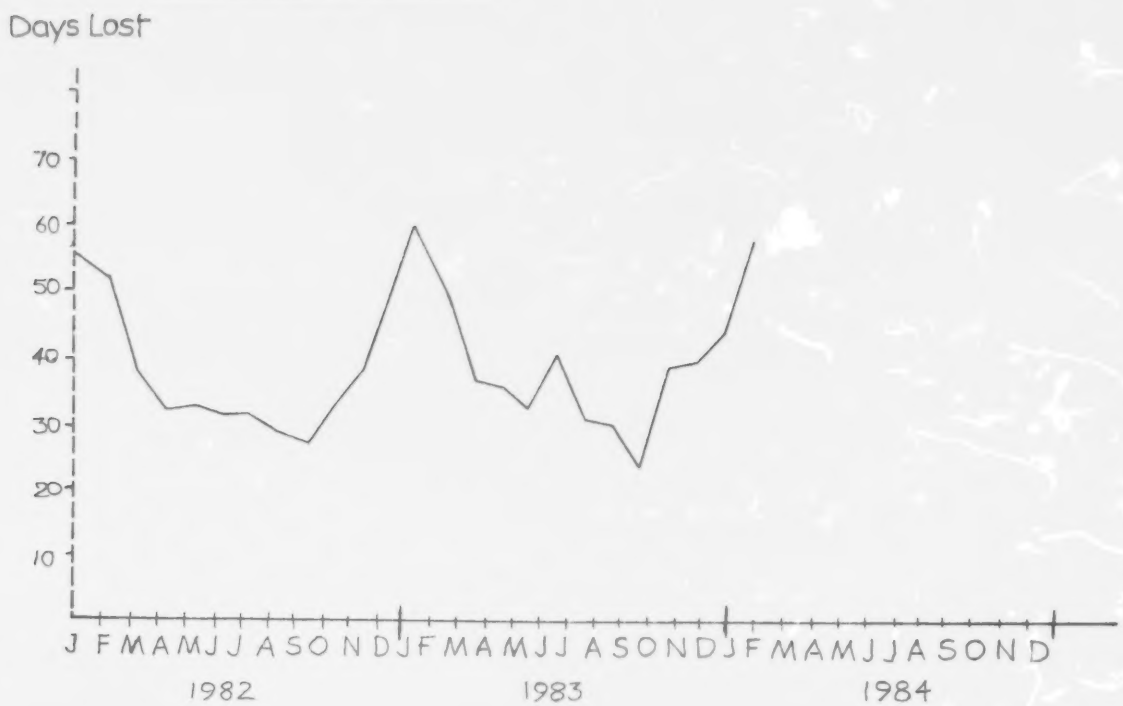
We then join these 2 points with a straight line. Check these 2 points then try the following Activity.

ACTIVITY 3
Time guide
5 mins

Now turn back a page or two to our graph of ABC Co where you'll see that only the first year's figures have been put in. Complete the graph for 1983 and January 1984. Don't forget to join the points with straight lines, this gives a clear picture of the changes. So now turn back to the incomplete graph, before checking out my graph below.

My completed graph looks like this

ABC Co.
SECTION 2
ABSENCE DUE TO SICKNESS



If your graph looks different to this then check out to see if you can agree with my graph.

ACTIVITY 4
Time guide
1 min

Now that we have drawn a graph and seen how a graph could make things easier for Bill let's think about the reasons for using graphs. Write down one good use of graphs.

* _____

REFERENCE 1
page 48

A list of figures doesn't always give us the information we want in an easily understandable way. Graphs on the other hand do give a clear picture of what is going on. You may also have thought about graphs as a way of making comparisons, or showing up patterns in data. In the book "Using Statistics in Business" you'll see many more uses for graphs - this is useful as it might give you some ideas not covered here.

OK, let's move on to explore further uses for graphs.

4 Understanding graphs

Now let's look at our completed graph. Several things are noticeable. The highest figures are between November and March, and the lowest figures are between June and September, in each of the two years for which we have data. This seems to be a pattern which repeats itself.

ACTIVITY 5
Time guide
2 mins

Note two possible reasons for high numbers of absences between November and March and lower numbers between June and September.

* _____

* _____

There could be a number of reasons.

* I expect you mentioned the tendency for sickness to be greater in the winter due to illnesses such as influenza, bronchial illness etc.

* Did you also think that there are fewer employees sick in the summer due to annual holidays being taken?

* Or that if the weather is cold and wet outside then people may be more inclined to take a day off if they feel a little out of sorts so as not to aggravate their illness.

What else does the graph tell us? Well, if we take another look we can easily see any figure which stands out and which would have been cause for concern at the time it occurred.

Well, looking at our graph there is an unexpected peak in June 1983. This did not occur in 1982 and there's no obvious reason for this.

ACTIVITY 6
Time guide
1 min

Jot down any reason you can think of why this high figure might have occurred.

* _____

There are many reasons why such an unexpected figure might have occurred. It could have been:

* a sudden epidemic;

* one individual with several weeks absence due to a major illness;

* or a group of dissatisfied staff tending to take extra days off.

SELF CHECK 1
Time guide
2 mins

Respond by completing each sentence with a suitable word or words.

1) Numeric information may be referred to as _____.

2) _____ may be used to look at data recorded over a period of time.

3) The _____ of the data may be seen by looking at the graph

4) Any unusual figures will _____ on a graph.

The answer to this self check is here in the following words, so you'll need to check out your answers carefully. 1 We could have used statistics but data is the term we've used here; 2 we used graphs to look at this data; 3 we could use pattern, or main features here; 4 we could use show up or stand out. Other words with the same meaning would also be suitable.

5 Summary

Graphs have a number of valuable uses:

* they help us to pick out the main features of data

* they make it easier to spot changes

* they help us to see if there's any 'pattern' in the data eg any features which repeat themselves

So a graph helps us to actually see changes and regularities in data and allows us to check their importance.

PART B READING GRAPHS

1 Introduction

Graphs, as we have seen, can tell us a lot about upward or downward movements in data. But can they also mislead us. We are all familiar with the Party Political Broadcasts which appear to 'prove' quite opposite points of view using figures, graphs, and other diagrams.

Disraeli once said there are three kinds of lies - "lies, damned lies and statistics". The word statistics here simply means figures. Peter Clark points out that "While statistics can be an invaluable aid to business it is perfectly true that they can be used merely to 'bamboozle' people".

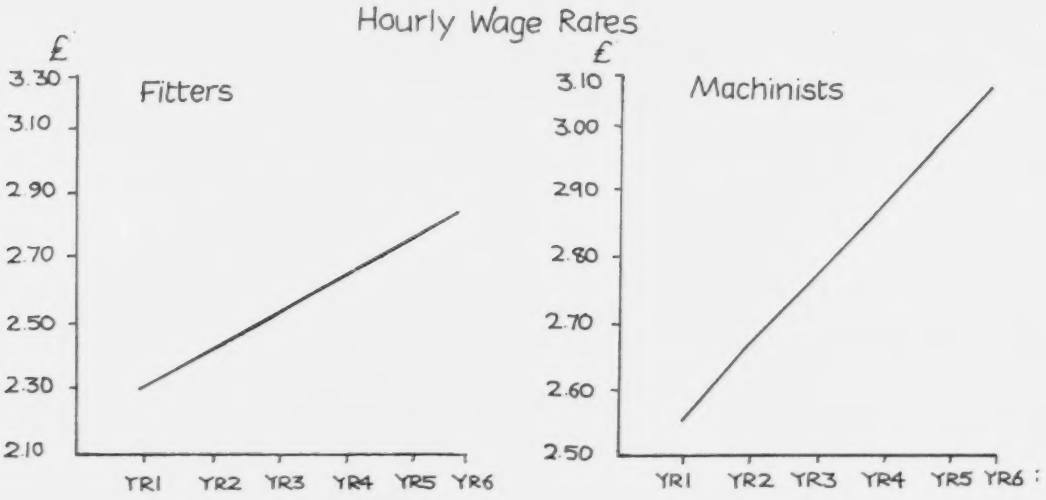
REFERENCE 2
page 48

Quite often people are confused by figures and graphs because they aren't too sure about the ways in which they can be misleading.

Let's see how this confusion can arise with graphs.

2 Misleading Graphs

These two graphs compare the wage rates for a group of fitters and a group of machinists over a six year period.



ACTIVITY 7
Time guide
2 mins

Write down what you consider to be the most noticeable feature of the two graphs.

* _____

_____

The line of the machinists wage rates goes up more steeply. Can we therefore conclude that wage rates for machinists had gone up faster? Well, it does look like it, but when we take another look it's not quite like that. The scale on each graph is written down the left hand side. The graph for fitters' wage rates goes up in units of 20p.(i.e. the first line is £2.10 and the second is £2.30 etc.). However the graph for machinists wage rates goes up in units of 10p. The effect is to make this line look much steeper.

Is there anything misleading in these graphs?

Well let's look at what the graphs are showing. At the top it says "Hourly Wage Rates'. Well, that's OK this is measured on both graphs.

Next we look at each individual graph in detail. The left-hand graph is headed FITTERS to indicate it is a graph of fitters' wage rates, and at the top of the vertical axis is a £ sign to show that wage rates are measured in £. The wage rates are then "scaled" up the axis from £2.10 to £3.20. Across the bottom of the graph the years are indicated.

We'll need to check these details in both graphs and make a proper comparison before drawing any conclusions.

ACTIVITY 8
Time guide
2 mins

Flick back to the graphs we looked at in Activity 7 and put the following information into this table and see where any differences occur.

		Left-hand graph	Right-hand graph
The graphs are headed -		* _____	* _____
The vertical axis is measuring -		* _____	* _____
The horizontal axis is measuring -		* _____	* _____
The wage rates are scaled:			
	from -	* _____	* _____
	to -	* _____	* _____

Look at this completed table and see where the differences are:

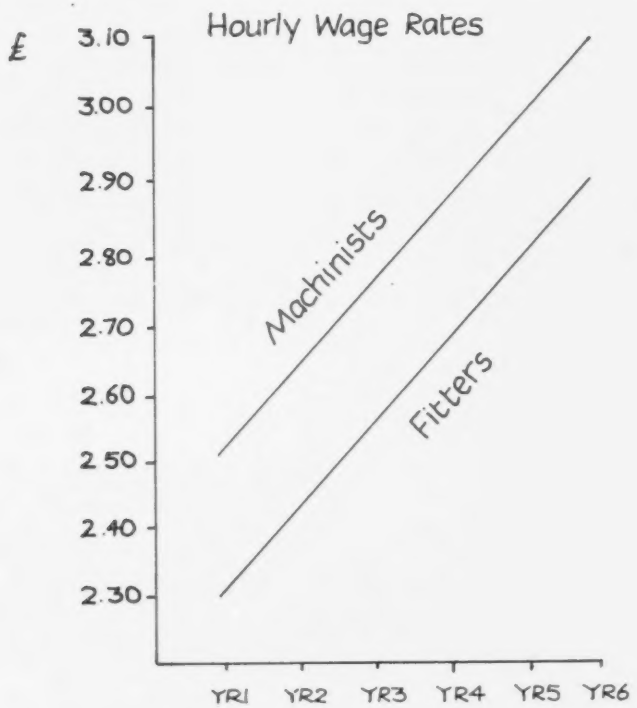
		Left-hand graph	Right-hand graph
The graphs are headed -		* Fitters	* Machinists
The vertical axis is measuring -		* £	* £
The horizontal axis is measuring -		* Year	* Year
The wage rates are scaled:			
	from -	* £2.10	* £2.50
	to -	* £3.20	* £3.10

Note that 2 items are different from the previous graph. One is the heading, noting a different group of wage earner, and the other are the values which are scaled up the vertical axis.

All these "labels" are quite correct, and if we take care in reading them we will not misunderstand the data. Nevertheless, the graphs have been displayed side by side in a way which invites us to compare wage rates. Because of the different scales used for the wages, the 2 graphs CANNOT HELP us to make the proper comparison.

A COMPARISON SHOULD NOT BE MADE BETWEEN GRAPHS USING DIFFERENT SCALES

Let's now look at plots of the same two sets of figures on a single graph.



Now a better comparison can be made between the two groups.

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ACTIVITY 9
Time guide
2 mins

What two points can be made about the wage rates of machinists and fitters from these two graphs?

* _____

* _____

Here's two things that can be said without much argument:

* machinists were paid more than fitters throughout the period and

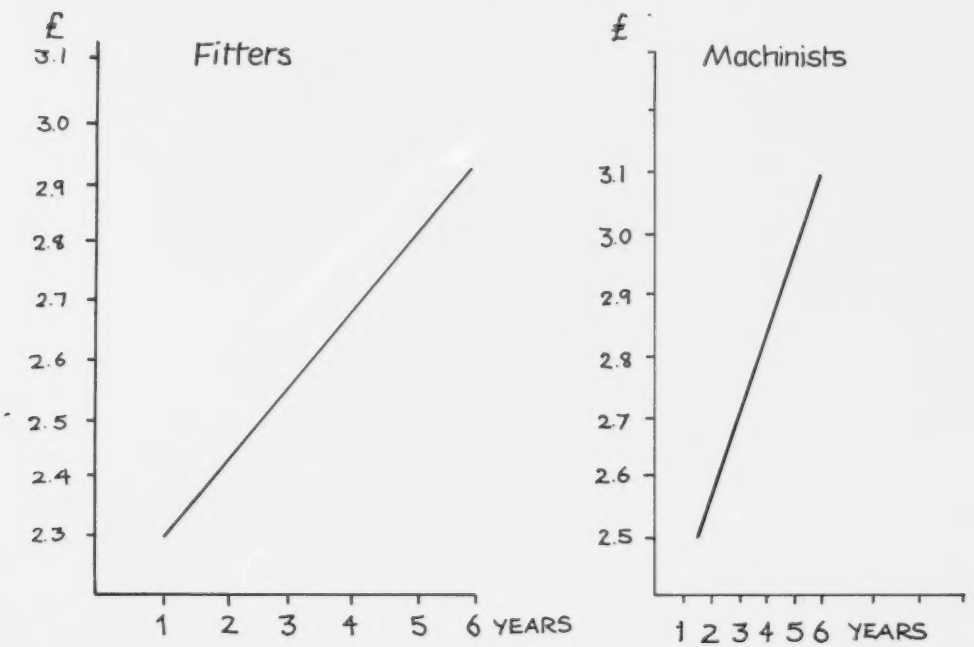
* machinists and fitters had steadily increasing wage rates over the 6 years.

We may have concluded that there is no difference in the rates at which the two wages increase. There certainly does not seem to be any difference on this graph. However, it can be argued that there is a difference but our graph doesn't really show this. So let's look at a graph which will show up any difference more clearly.

3 Further distortions

It is not only the vertical scale which should be read with care. Distortion can also be created by differences in the horizontal scale.

Look at the same data on wage rates on the following two graphs.



On these graphs the machinists' wage rates appear to be rising more quickly i.e. the line is much steeper.

12

ACTIVITY 10
Time guide
2 mins

Write down anything about the 2 graphs which you think may cause them to be misleading.

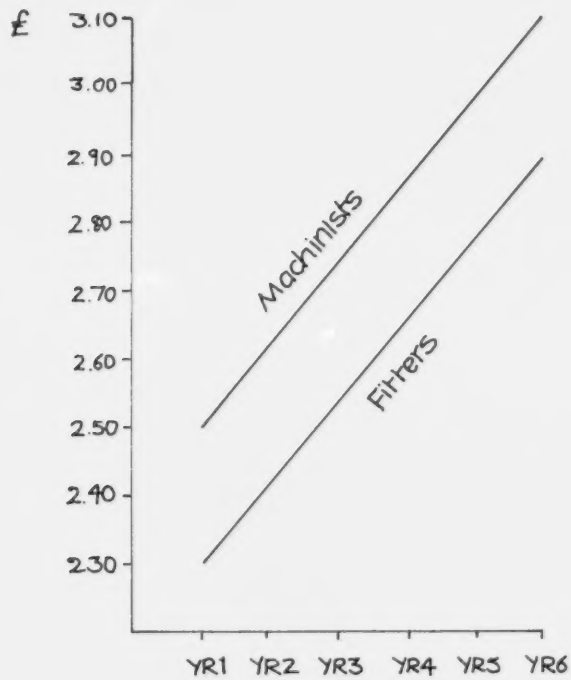
*

The horizontal scale is in fact measured in different sized units. A larger space has been left between each year's figures on the left hand graph than on the right hand graph. The effect of this is to make the line in the right hand graph rise more steeply.

Note that the vertical scales are, in fact, identical i.e. both graphs go up in units of 10p.

IN COMPARING GRAPHS WE SHOULD ENSURE THAT THEY ARE DRAWN ON THE SAME SCALE VERTICALLY AND THE SAME SCALE HORIZONTALLY

Look what happens when exactly the same scales are used horizontally and vertically.



So we need to take great care when interpreting data which is presented on more than one graph and check for any differences in scales and labels.

SELF CHECK 2
Time guide
5 mins

On the next page are 4 sets of graphs of average weekly earnings for two groups of people, one a group of typists and the other a group of (non-typing) clerical staff.

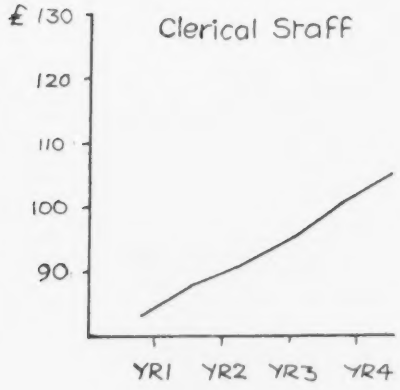
1) Which pair of graphs A, B, C or D is the greatest help in comparing the data _____

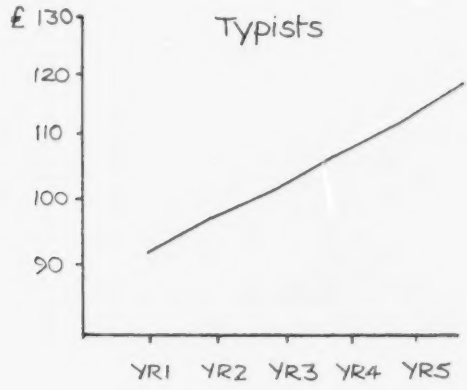
2) Respond to each statement by writing TRUE or FALSE in the space provided.

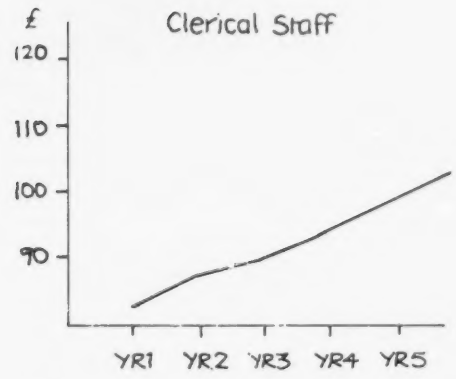
   a) the group of typists earn more than the group of clerical staff _____

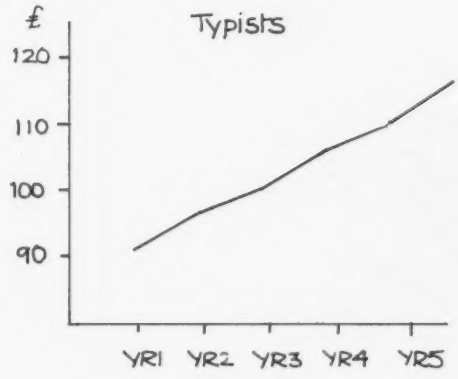
   b) the clerical staff's earnings have risen faster than the typists' earnings _____

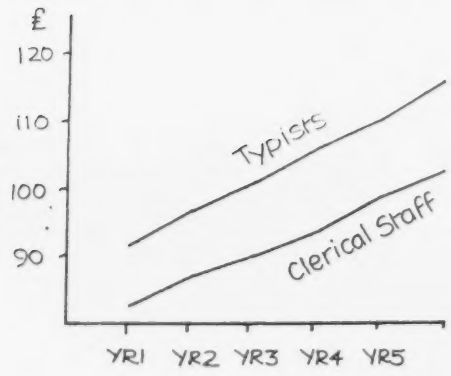
AVERAGE WEEKLY EARNINGS

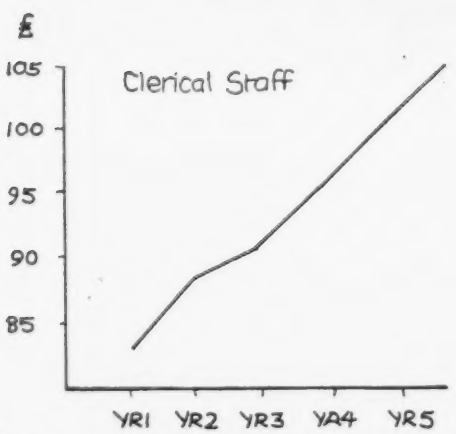


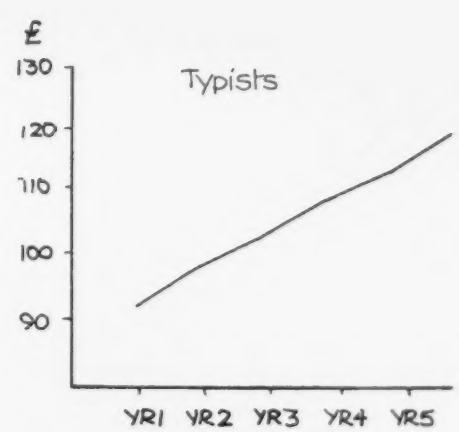












15

The answer to this self check is here in the following words, so you'll need to check out your answers carefully. 1) C, this graph allows us to see what the difference in earnings of the two groups is, as well as how much each group earns. If you thought B was better, try reading from the graphs how much more the typists are paid in YR3 than clerical staff. It can be done, but is easier on graph C. Graph A is misleading because the amount of space left between the years is smaller on the left hand graph than the right hand graph. Graph D is very misleading; it looks as though clerical staff earnings have increased much more quickly than typists. Twice as much space is allocated to £5 on the left hand graph as on the right hand graph. 2) a) true, there is no year where clerical staff earn more than typists; b) false, you can verify this answer by looking carefully at graph C.

4. Comparing changes

Even when we take all this care, we can still get it wrong! To see how, let's look at the following case incident.

> A discussion was taking place between Bob, who was a supervisor, and Jim, an electrical trades shop steward, as to whether a new wage deal which was in the process of being negotiated was a fair offer. Bob felt it was a fair deal because everyone was getting the same offer of an extra £10 per week. "After all", he said, "that £10 will buy the same amount for everyone."
>
> Jim, who had just come back from a training course said, "No, you've got it wrong Bob. If we all get the same amount then our differential over the plumbers would be reduced. If we kept on like that every year then eventually our differential would be worth nothing. We must go for a percentage increase."
>
> Currently, plumbers were earning £100 a week and electricians £120 so the proposed increase would give plumbers £110 and electricians £130. Bob, who had always been a bit weak on percentages, thought there was something in what Jim was saying, but he didn't quite understand.

This is typical of many arguments which take place during negotiation - should wage increases be flat rate, or percentages? In order to understand better what they are arguing about, let's have closer look at the figures Bob and Jim were looking at.

Perhaps we should pause here to see what we mean by a "differential". At the moment, plumbers' basic wage is £100 p.w. and the electricians' £120 p.w. One way of describing the wage "differential" is simply to call the £20 p.w. that the electricians earn over what the plumbers earn, the differential. This is how Bob sees it.

But Jim thinks differently. He thinks that the differential is best described as a percentage - we'll see why in a moment. So the electricians differential is 20% - Jim worked this out by reckoning that the electricians earn 20% more than the plumbers.

ACTIVITY 11
Time guide
3 mins

How would Jim have worked this percentage out?

Do your own calculation here:

*

Well the way to calculate this "percentage" differential is first find the difference in wages, £120 - £100 = £20 then we see what this figure is as a percentage of the lower wage - thus 20 divided by 100 = 20%. This is how Jim describes the differential.

Unless Jim and Bob can agree on just ONE WAY of describing this differential there will always be arguments about the paydeal.

5. Percentages

Before we start, we will be doing some calculations now, so if you can get hold of a calculator now it would be handy. But don't worry if you haven't got one - it really doesn't matter the figures are not difficult - I just thought that here's your chance for some practice!

You'll recall how Jim calculated the wage differential? He said that the electricians earned 20% more than the plumbers - if they each got a £10 p.w. rise would this still be the case? Well, no it wouldn't - look at what would happen:

Plumbers' new wage = 110 p.w.

Electricians' new wage = 130 p.w.

Now Jim would work out the differential as he did before, but with the new figures. Difference in wages is £20 and 20 divided by 110 is close to 18% - So Jim would argue that the differential has changed. You remember he reckoned that if all future wage rises were "flat rate" then in the end differential would be worth nothing. Looks like he could be right!

But what's Bob's point - he would reckon he was right too. If all groups got a £10 p.w. rise then they could all spend the same amount to maintain or improve their life styles. Before their rises the wage differential was £20 so this is OK - the differential hasn't changed.

Well we can now see that they are both right in their own way - they just can't agree on the same way!

Let's return to our case incident with Jim and Bob to see how argument could arise. Let's see how Jim and Bob would feel about these two proposals. Management propose a flat-rate increase for plumbers and electricians of £10 p.w. but the Union propose a 10% increase in wage rates. We have already seen that Bob and Jim don't agree about what's "fair", so let's see how we might help.

First we should settle what both proposals would mean.

ACTIVITY 12
Time guide
3 mins

1 Proposed £10 p.w. - write in the new wages :-

Plumbers = £ Electricians = £

2 Proposed 10% increase - calculate the new wages

Plumbers = £ Electricians = £

Under proposal 1 the Plumbers would earn £110 p.w. and the Electricians £130 p.w. Under proposal 2 the Plumbers would get 10% of £100 more, then they would earn 100 + 10 = £110. The Electricians would get 10% of £120 more and and earn 120 + 12 = £132 p.w.

Now you will recall that we said graphs are useful in letting us see the main features of data. Well if this is so, then we could put this argument over "differentials" onto a graph to help clarify the position that Bob and Jim can't agree about.

It always helps to draw up our figures into a small table before plotting the graphs - so let me calculate the necessary figures. You might check them out to see that I've done my sums properly!

TABLE 1 - Wages over the next six years based on a £10 p.w. flat-rate increase:

	Now	1985	1986	1987	1988	1989
Plumbers:	100	110	120	130	140	150
Electricians:	120	130	140	150	160	170

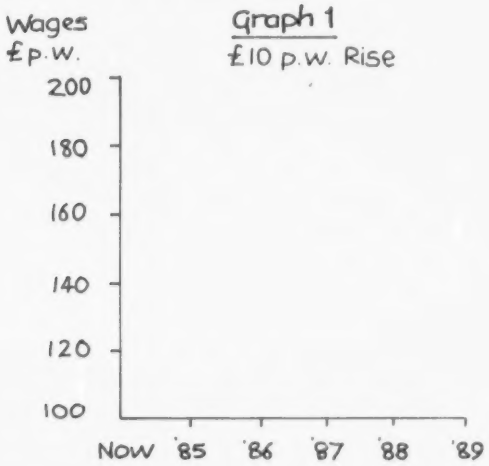
TABLE 2 - Wages over the six years based on a 10% p.w. increase in year's wage:

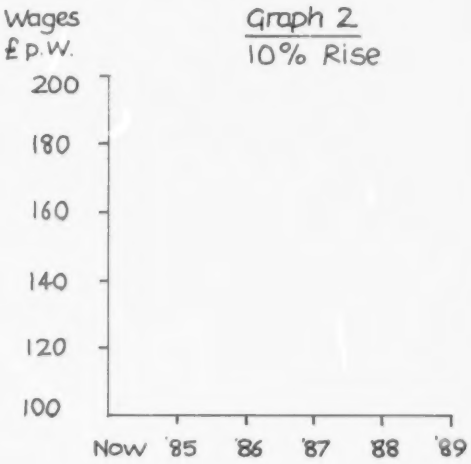
	Now	1985	1986	1987	1988	1989
Plumbers:	100	110	121	133	146	161
Electricians:	120	132	145	160	176	193

In this last table I've put the wages to the nearest £. You'll also see each year's wage is 10% more than each previous year's wage.

SELF CHECK 3
Time guide
10 mins

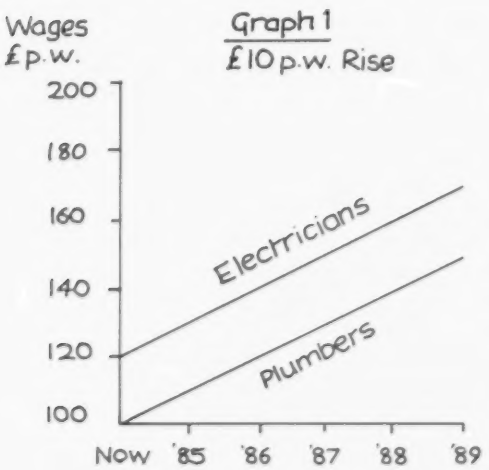
Plot the figures on the blank graphs below. Put the TABLE 1 figures into graph 1 and TABLE 2 figures into graph 2. Join up the points for each set of figures so you'll end up with 2 lines on each graph - Don't forget to indicate which line represents the Plumbers wages and which the Electricians.

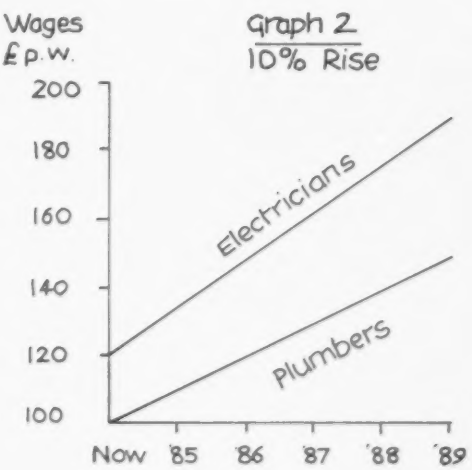




You'll have to guess where some figures for wages are - this is OK it won't affect our conclusions.

Here are my graphs to help you check:





So we can now 'see' Bob's case. At £10 p.w. flat rate rise the wage differential remains constant - the lines in Graph 1 are parallel. At a 10% wage rise the lines get further apart year by year, so Bob claims this is unfair as the "differential" appears to be getting larger.

Now to Jim's argument. He will, of course, use the same figures that Bob used, but he would "present" them differently. Let's look at the tables of figures he would use:

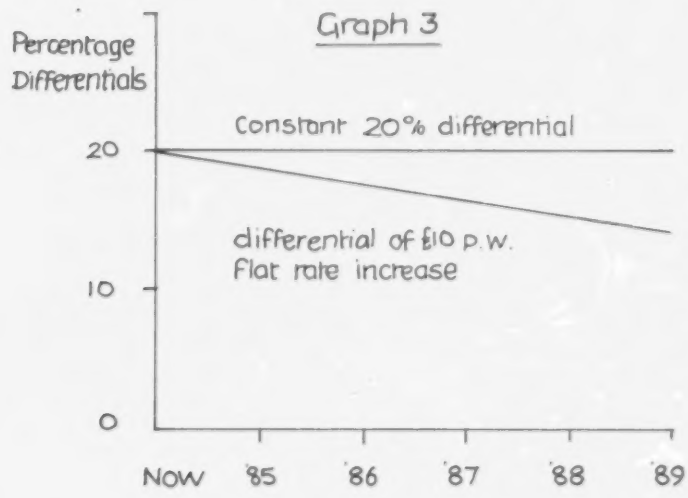
These are a repeat of some of our earlier figures - all that Jim does is to calculate the PERCENTAGE DIFFERENTIAL between the wages year by year based on a £10 per week flat rate rise and put these into a graph. So we'll do this ourselves:

TABLE 3 - Wages over the next six years based on a £10 p.w. flat rate increase:

	Now	1985	1986	1987	1988	1989
Plumbers:	100	110	120	130	140	150
Electricians:	120	130	140	150	160	170
Percentage differential:	20	18	17	15	14	13

You'll recall how we calculate the percentages - for 1985, 18% is the wage difference of £20 (eg £130 - £110) divided by £110 (eg the lower wage).

When we put this last row of percentage differential figures into a graph and also put in the constant 20% differential that Jim wants to keep, then this is the picture:



So we can now "see" Jim's case. He sees that a £10 p.w. flat rate increase causes the 20% differential now to fall to 13% in 1989.

So what does this tell us? Well, we already know that we need to be very careful when comparing graphs to see that the horizontal and vertical axis are the same. We now have learned that the kind of data we put into our graphs also has an important effect. Look at graphs 2 and 3 again - they appear to contradict each other, but now we know that they don't!

Bob and Jim need to appreciate each other's argument and agree on a single definition of "wage differential" - they have no dispute over facts - then their disagreement may be resolved.

It's worth pointing out here that it's not only the way in which data is presented that can confuse us. Problems can, for example, arise because of the ways in which it's collected. There are a lot of ways in which distortion can creep in to statistics. The disagreement between Bob and Jim is an example of how personal views can affect the way in which we look at facts. They hadn't realised that they needed to define the term "wage differential" before they could remove their personal views from their judgements of each other's case.

REFERENCE 3
page 48

The book "Using Statistics in Business" gives other examples of these kinds of difficulties. It gives examples where statistics can confuse if we don't take care in their use. It's not that statistics tell lies, they don't. But they can confuse if we're not careful about how they are used.

Now let's return to the argument between Jim and Bob. We've seen that they were having problems over the definition of "wage differential". A main concern in their minds would be inflation. Let's see what this has to do with their argument.

6. Inflation

The argument between Jim and Bob is not a frivolous one - they are arguing about something quite real. There's been so much talk in recent years about inflation that we hardly need to explain what it is, but to pursue our point we need to note what inflation is. Let's settle for this description:

INFLATION IS THE PERCENTAGE RISE IN THE COST OF LIVING OVER ANY PERIOD WE CARE TO CHOOSE

When Bob and Jim are arguing over an annual wage rise they will both be concerned with inflation over the year since their last rise in wages.

SELF CHECK 4
Time guide
1 min

So if inflation rose by 7% since their last pay rise then to keep level with this, would our Plumbers and Electricians need a £7 p.w. rise or a 7% rise in their pay?

* _____

The answer to this self check is here in the following words, so you'll need to check out your answer carefully. They would need the 7% rise, we have already covered the reasons. Do you recall when the Plumbers got a 10% rise? The Electricians also needed a 10% rise to keep up with them. It's just the same with cost of living and wages. If the cost of living rises by any percentage then to maintain the same relationship wages would need to rise by the same percentage.

I only use this example to extend Bob and Jim's argument to another factor - inflation. However we do understand that wage bargaining is a very complex affair and we have no "God-given" right to have a pay rise either equal to or higher than the rate of inflation - though we would want it!

EXTENSION 3
page 47

If you would like to explore the complexities of determining pay levels further, you might like to take up our third extension which highlights the aims of payment systems and details the factors influencing pay rises. If you take up this extension you'll be more aware of the issues involved in determining pay rises, including those of differentials and inflation, which we've already looked at.

7 Labels and Headings

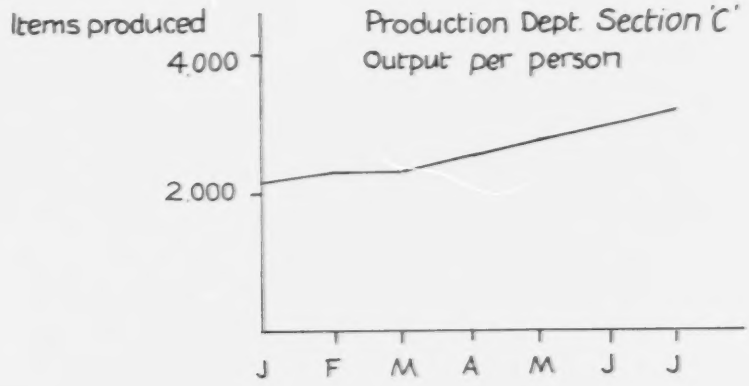
Just a final word about the words we write on graphs to describe what we are showing - that is, labels and headings.

When we draw conclusions by "reading" graphs we must take careful notice of what the graph is showing. For example, in our earlier case of Plumbers and Electricians we would be careful to check which line represented the Plumbers and which the Electricians. We would also check whether the graph showed wage rises in cash or percentages year after year.

CHECKING OUT LABELS AND HEADINGS ON GRAPHS IS
ESSENTIAL TO DRAWING THE APPROPRIATE CONCLUSIONS

ACTIVITY 13
Time guide
2 mins

Suppose you have just been transferred to supervise a new section. On the first day you notice the following graph on the wall showing output from your new section.



Which of the following would be reasonable conclusions to draw from the graph.

a) The section is becoming more efficient

b) The section's output is rising

c) The product is selling well

d) The team are working more effectively

You'll need to check each conclusion carefully here - some of the arguments are a little complicated:

* Conclusion a) As the output per person is rising we could reasonably claim that the section is becoming more efficient.

* Conclusion b) we couldn't claim that this is true, eg if half the staff are on holiday and the other half work better then output per person could rise though output of the whole section will probably fall.

* Conclusion c) We certainly couldn't claim this to be true from the evidence of the graph -it may or may not be selling well we can't know.

* Conclusion d) This may well be true - if there was no other reason like more efficient machines or better raw material, then the people must be working better.

So we are reminded: when we "read" graphs we must:-

STUDY THE LABELS AND HEADINGS ON ANY GRAPH BEFORE DRAWING CONCLUSIONS

8. Summary

Graphs can show up regularities and irregularities in data:

regualarities eg TRENDS which rise or fall

and SEASONAL VARIATIONS

irregularities eg unexpected changes we called RANDOM VARIATIONS

Before comparing data by using graphs we need to see that they are comparable by checking:

the headings - so we compare the same things

the axes - to see that the scales are the same

the labels - to see that the scales are measuring the same data

If the graphs have any of these differences then comparing is difficult and often misleading.

PART C FORECASTING WITH GRAPHS

1 Introduction

REFERENCE 4 page 48

Forecasting is about looking ahead in time, and as Betts points out, trying to visualise and plan effectively. Forecasting can help us to plan - when you think about it, it's impossible to plan without some kind of forecast however rough and ready this may be!

When we look at any data recorded over time, there's a number of features we expect to find.

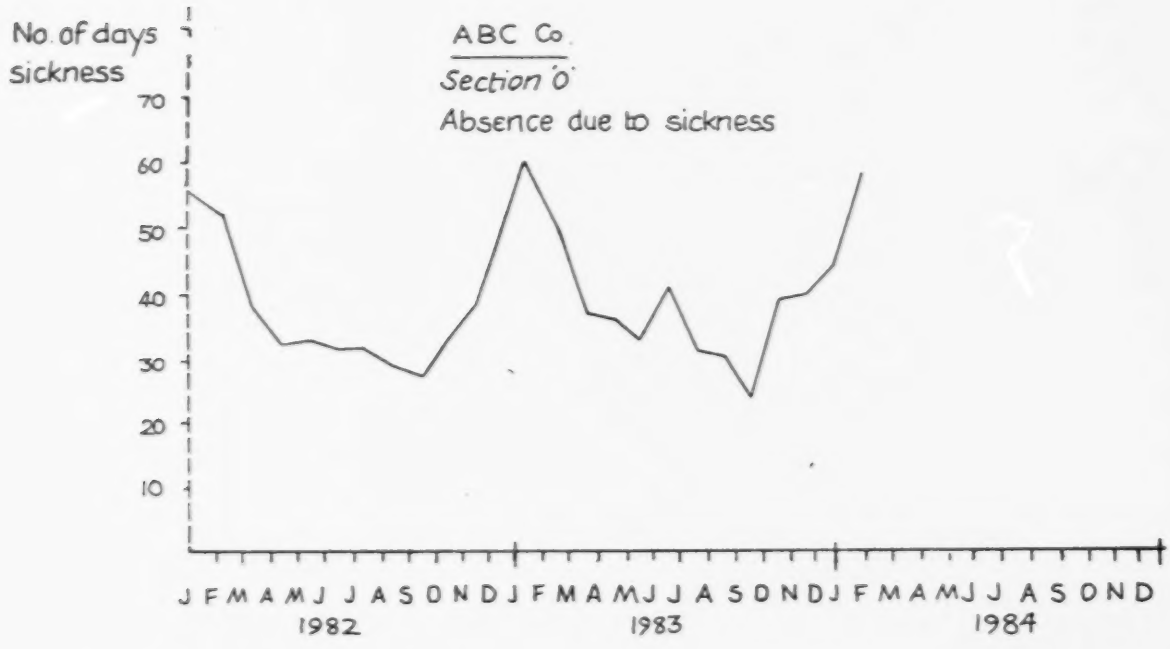
For instance the graph may show a line varying a little up and down but generally remaining at the same horizontal level year after year.

The line may generally rise or generally fall or it may rise regularly each summer and fall each winter - like sales of ice cream.

These and other variations are worth exploring as they will help us to spot trouble or even prevent trouble before it arises. However some data cannot be forecasted - this kind of data may be due to sudden unexpected variations. Examples of this are strikes, accidents and even snap elections, all of which can cause movement in data, but none of which could be confidently predicted.

2 Patterns in Data

Let's say you are very concerned because sickness has suddenly increased in January, just after you have taken over as supervisor. You draw a graph of the sickness figures for the past 2 years which is shown here:



ACTIVITY 14
Time guide
3 mins

What information can we draw from this graph? For instance there is no general trend upward or downward across the two years.

1 What <u>two</u> other remarks can you make about the graph?

* _____

* _____

2 Should you be worried about the sudden increase in sickness in January 1984 when you took over the section? YES/NO

Briefly explain your answer

* _____

Remarks we could make are that:

* there is a rise in sickness over the winter months;

* there is also a fall in the summer months;

* we can also see an unexpected rise in June 1983 that wasn't there in June of 1982.

I don't think you should be too worried about the rise in your first month as supervisor, because the rise seems to be repeating itself year by year. Of course you would always be concerned about rising sickness on your section but in this case you need not be too alarmed - it's clear that it's not your fault!

When there are "patterns" like this, then we can use the information the "pattern" gives us to forecast the future data. So what kind of "patterns" are there that we might be able to detect? We'll restrict our attention to two common kinds; one is seasonal variations and the other is trends. Let's explore each of these in some detail.

2.1 Seasonal Variations

We agreed earlier that the reason for sickness figures being higher in winter could be largely due to the bronchial troubles, colds, influenza etc. at that time of year. We also thought that poorer weather conditions may make people more inclined to stay away from work if they don't feel too well. Variations such as this are called <u>SEASONAL VARIATIONS</u>.

Seasonal variations are sometimes related to weather changes but also cover any changes which take place at a specific time of year e.g. increase in sales of toys at Christmas and increase in sales of wedding dresses at Easter.

ACTIVITY 15
Time guide
1 min

Make a note of TWO seasonal variations you expect to find in data you handle at work.

eg fewer people leaving their job just before Christmas

* _____

* _____

Clearly your answer will vary with the type of work that you supervise but some examples might be:

* higher output of fashion goods prior to summer/winter season
* large amounts of overtime in Local Authority work on snow clearance in the winter
* low numbers of employees leaving the organisation during the summer (holiday period)
* low absenteeism in the weeks before holidays

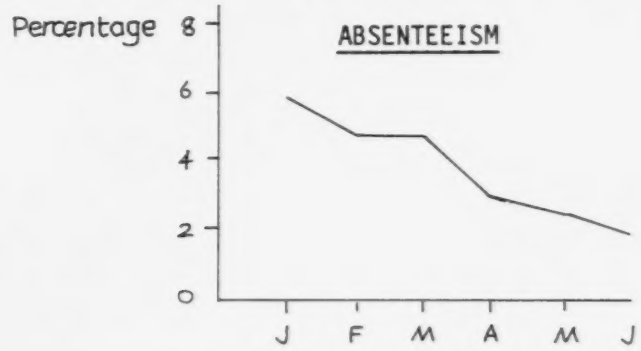
Provided that your examples are of data which change each year at the same time, then they are examples of seasonal variations.

ANY CHANGE IN DATA, EITHER UPWARD OR DOWNWARD, WHICH OCCURS EACH YEAR AT THE SAME TIME OF YEAR IS A SEASONAL VARIATION

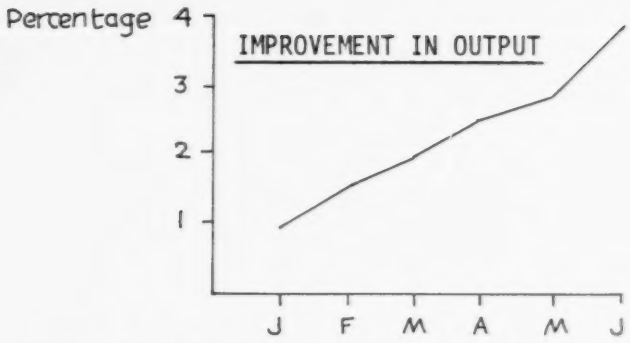
2.2 Trends

So what is a trend? Because we are using graphs to illustrate our data, perhaps we should ask "what does a trend look like?".

Here are two graphs showing trends which you would be pleased about if the data came from your work section.



Although the line is not perfectly straight, it's easy to see that it is gradually falling - A DOWNWARD TREND



Once again, not a perfect straight line but it shows - AN UPWARD TREND

ACTIVITY 16
Time guide
2 mins

Lots of data exist at your workplace - write down TWO pieces of such data that could show a TREND if it were to be plotted on a graph:

eg Absenteeism

* _____

* _____

The variety of data where we would look for a trend is considerable but typical examples are:

* Minor accidents
* Output improvements
* Days lost due to strikes
* Customer complaints
* Reject or scrap rates

This data and other similar data could show a trend - your job as a supervisor is to get the trends in the right direction and keep them there. So we are clear that:

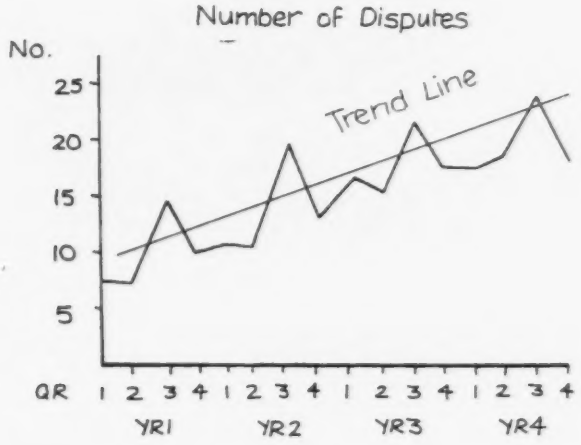
A TREND IS A GENERAL UPWARD OR DOWNWARD MOVEMENT IN DATA

We accept that whether we plot our data on a graph or not, a trend can still be there in the figures, though not always as clearly obvious as would be the case in a graph.

Very often, when there is a TREND, it is not so easy to see. The general rise or fall of a trend may be "hidden" by larger variations than the ones shown here. We can imagine the situation if there was a trend and a seasonal variation together in the same graph! Yes, there would be some confusion - but there is a way of handling this, we'll see what this is after this Self Check.

SELF CHECK 5
Time guide
2 mins

Have a look at the graph below and then complete the sentences describing the main features of the data.



1) The data peaks in the third quarter of each year, this is an example of a _____ _____

2) The general direction of movement of the data is _____

3) The general direction of movement of the data can be referred to as _____

The answer to this self check is here in the following words, so you'll need to check out your answers carefully. 1) seasonal variation, or sometimes called periodic variation; 2) upward, rising or increasing; 3) a trend, an upward trend or a rising trend.

In this data we have been able to identify both seasonal variations and an underlying upward trend. This example is different to our example of seasonal absenteeism where there was no trend neither upward nor downwards.

I have included an additional feature on this graph - the TREND LINE. By drawing a STRAIGHT LINE through the graph line or data it's much easier to see the TREND. So if we suspect that there is a trend in data, then by drawing a straight line through the data we'll be able to see if we are right.

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2.3 Other variations

There are other variations in data which occur for reasons which have nothing to do with a trend or seasonal variations. We found one example in the graph in section two of this Part C, where a sudden peak can be seen in June of 1983, which doesn't occur again. So we have no way of knowing whether or when it will happen again. In this case we say it's a RANDOM variation.

SELF CHECK 6
Time guide
2 mins

Here are some terms we have used in our unit:

TREND

DATA

RANDOM VARIATION

SEASONAL VARIATION

Drawing from this list write against each description the appropriate term.

Changes in data which are repeated at regular intervals _____

A general direction of movement of data _____

Changes in data which are not predictable _____

Information which can be measured numerically. _____

The answer to this self check is here in the following words, so you'll need to check out your answers carefully. Changes in data which are repeated at regular intervals - seasonal variation; A general direction of movement in the data - trend; Changes in data which are not predictable - random variation; Information which can be measured numerically - data.

In our introduction to this Part C you'll recall our claim that in order to PLAN we must first conduct a FORECAST. We have seen so far that when we spot patterns like TRENDS and SEASONAL VARIATIONS in our data then we are able to make FORECASTS. So we can now move on to see how we can do this.

3. Forecasting

In making a forecast based on past data we can only use trends and seasonal variations. A trend can be forecast, because it is based on data over a relatively long period of time and we do not expect sudden changes in it. Seasonal variations we can forecast because they are repeated each year. However there is a problem with random variations. As the word "random" implies, we cannot forecast random variations because these movements will be unexpected both in timing, in direction and in size. So we will deal with data containing trends and/or seasonal variations.

Let's look at a Case Incident which has in it some data which contains both a SEASONAL VARIATION and a TREND.

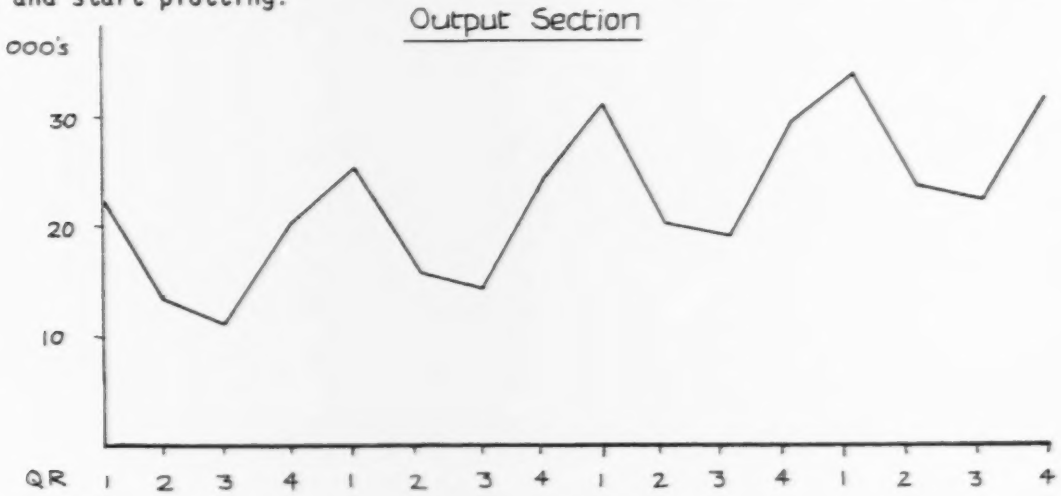
Case Incident

Bill, the supervisor, was promoted at the end of the year - it is now the middle of March. He has just received another computer printout - this one shows the output of his section for the whole of the previous year. He knows that data for earlier years are kept on file and he now wants to make a forecast of output for the coming year. This will enable him to see where actual output falls below what would be expected, and so investigate the reason.

After searching through the files he found the following data for the last four years.

QR	1	2	3	4
YR1	20	12	10	18
2	23	14	13	22
3	28	18	17	26
4	30	21	20	28

His first step after finding the data was to draw a graph and try to identify the main features of the data. Here is the graph he produced. You might like to draw your own graph as we work through this example - if you do then get hold of a sheet of graph paper and start plotting!



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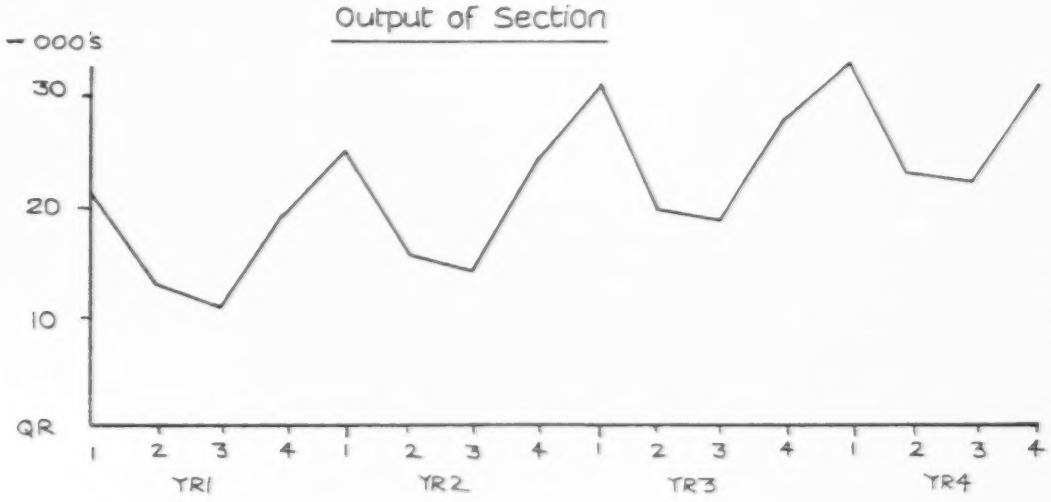
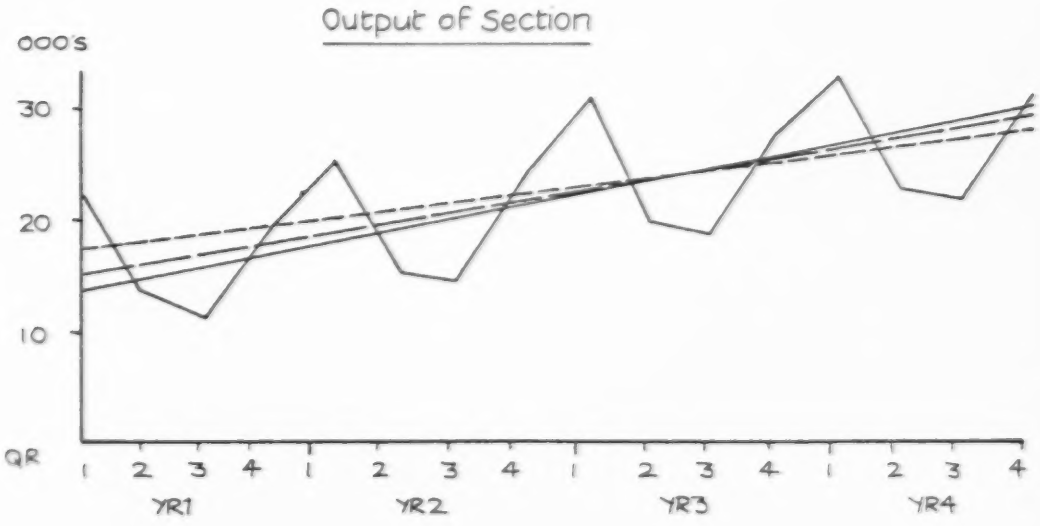
Now it's clear that this graph has in it a seasonal variation and a rising trend. We'll start by dealing with the trend.

ACTIVITY 17
Time guide
1 min

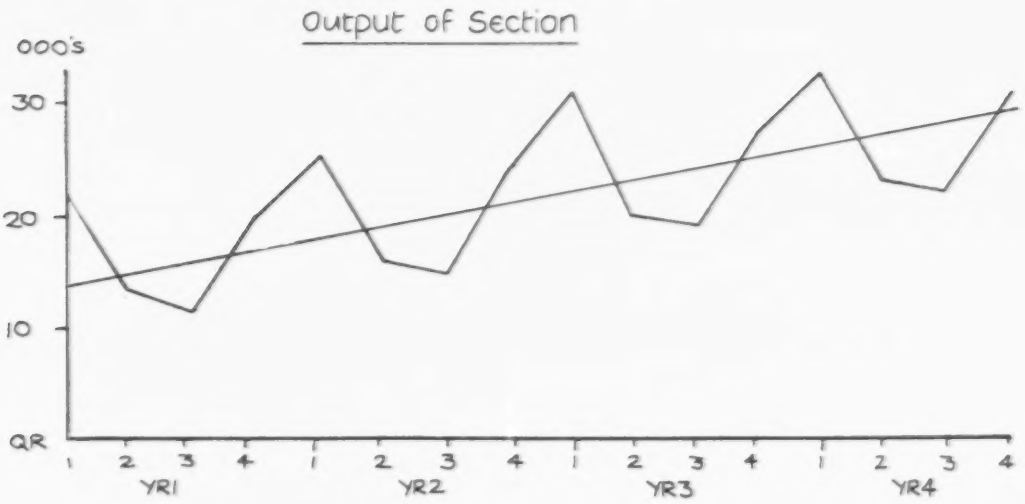
Have a look at this graph or the one you have drawn of the data on output from our case incident and draw a straight line through the data to show the trend.



It's quite difficult isn't it? Any of the following lines seem to reasonably fit the data.



But perhaps the 'best' line is one which seems to be in the middle of the graph like this:

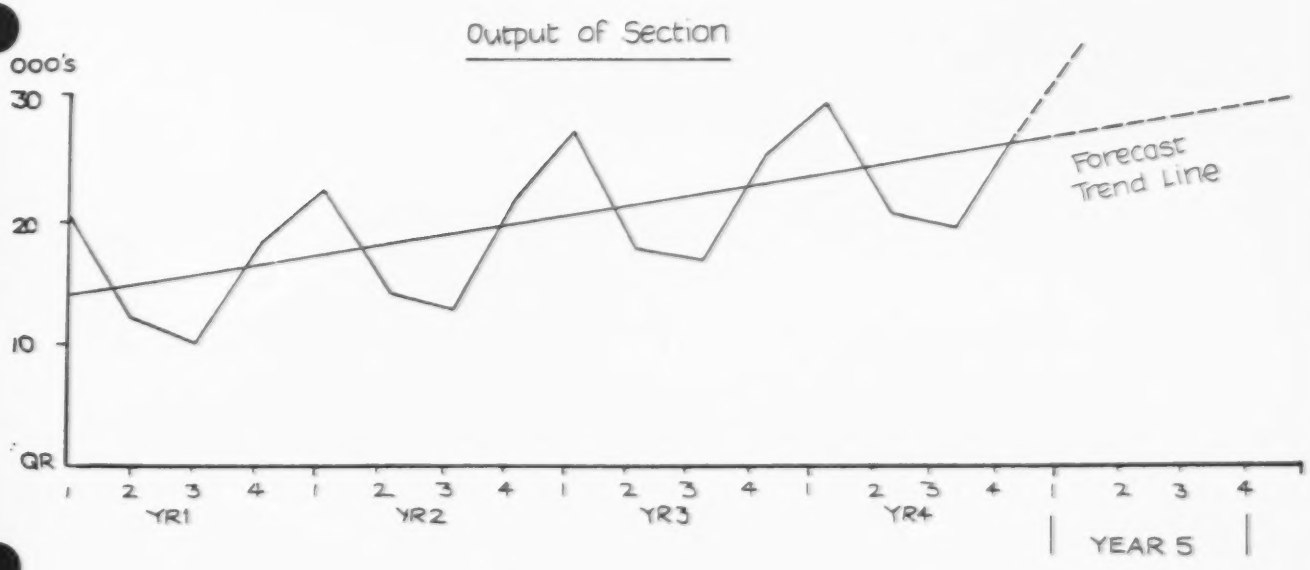


Because we are dealing with data on a graph and wish to establish a useful and easy method, then our 'best' lines may not be exactly the same - that doesn't matter it's the idea we are interested in.

Having got our trend line in we can move on to see how this can be usefully used.

Having put in the line, we now want to FORECAST the data for the next year so we EXTEND OUR TREND LINE FORWARD through the next four quarters. Use a different colour or a broken line on the EXTENDED part of the line to show that it is a forecast.

Our completed graph will now show the forecast trend line going to the end of Year 5.



ACTIVITY 18
Time guide
2 mins

Use this graph to read off a forecast trend value for each quarter. We cannot read these accurately so read the values off to the nearest 500 (i.e. half a small square). I have filled in the first two values so check those first. The values to read are the centre points of the circles.

QR		YR5 TREND VALUE
1		27000
2		28000
3	*	_____
4	*	_____

The four forecast trend values are:

	Yr 5 TREND VALUE
QR1	27000
2	28000
3	29000
4	31000

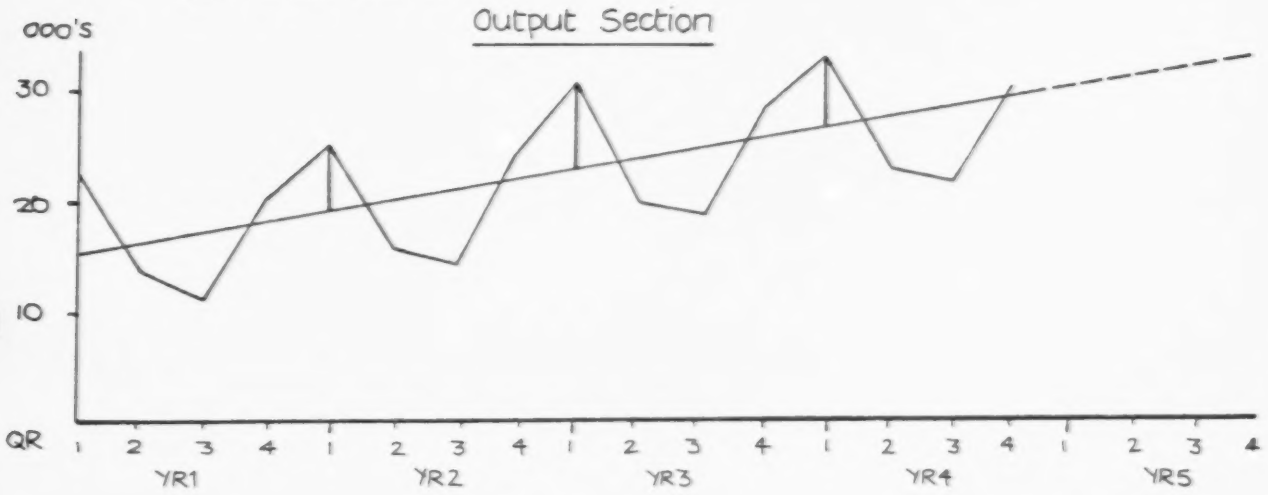
Of course our figures may not be exactly the same but they won't be far out.

Now we have forecast the trend values for year 5, we can deal with our seasonal variations.

We'll look at the first quarter in each year first to see how far above the trend line the actual output is. Then we will assume that the first quarter of year 5 will show the same pattern. So the output will be above the trend line by the same amount as before. We'll be clearer about this when we've done an example.

ACTIVITY 19
Time guide
2 mins

So take the first quarter for the last four years and measure how far above the trend line it is. The distances are marked on my graph below, you could also put these lines in on your graph and do your own calculations using mine as a check on the method. I have taken the first two measurements and put them here, you can enter the values for year 3 and year 4.



		Year			
QR1	DISTANCE FROM	1	2	3	4
	TREND LINE	6,500	6,000	* _____	* _____

The complete set of measurements is:

		Years			
QR1	DISTANCE FROM	1	2	3	4
	TREND LINE	6,500	6,000	7,500	6,000

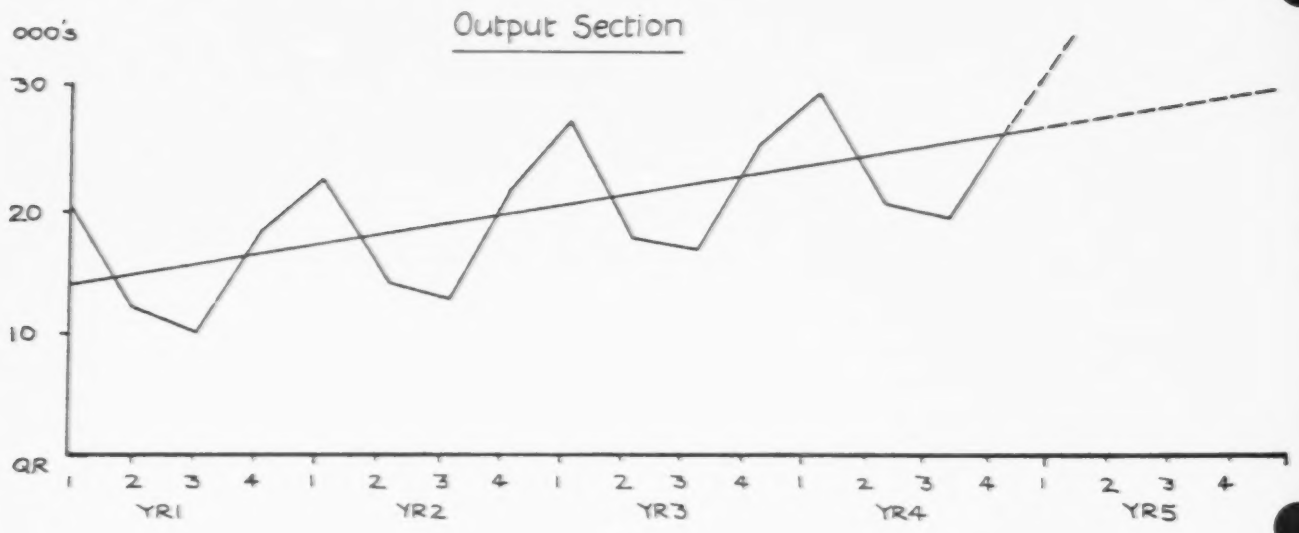
We now want to find the average distance i.e. the average of the four values. We do this by adding the four values together and dividing by 4.

TOTAL = 6,500 + 6000 + 7,500 + 6000 = 26,000

Average = 26,000 $\div$ 4 = 6,500

Right, so in the first quarter of YR5 the actual value will be 6,500 ABOVE THE TREND LINE.

Let's now plot this figure on the graph.



I have again used a broken line to indicate that this figure is a FORECAST. You may find using colour is more effective for distinguishing between actual figures and forecast figures.

ACTIVITY 20
Time guide
7 mins

Right, we now repeat this procedure for each of the next 3 quarters. You'll need to note the measurements for Qrs 2, 3 and 4 and work out the average. It doesn't make any difference if the graph is below the trend line - just take the measurements as you did before:

We've done Qr1 but I've put them in again as a check:

	Qr1	Qr2	Qr3	Qr4
YR 1	6,500	* _____	* _____	* _____
YR 2	6,000	* _____	* _____	* _____
YR 3	7,500	* _____	* _____	* _____
YR 4	6,000	* _____	* _____	* _____
TOTAL	26,000	* _____	* _____	* _____
AVERAGE	6,500	* _____	* _____	* _____

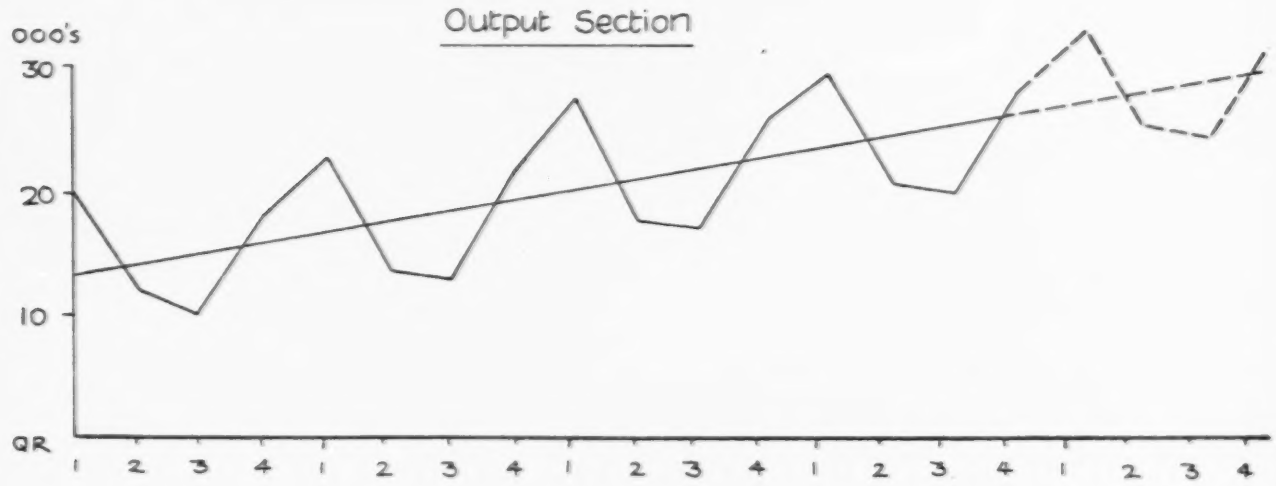
(Average = Total ÷ 4)

Note - the AVERAGE is the average distance from the TREND LINE, we should also note whether each average is above or below the trend line.

The four figures we are interested in are the last four in our table. We must also note whether the actual graph line is ABOVE or BELOW the trend line. So in QR1 the value is 6,500 above; in QR2 the value is 3,300 below; in QR3 the value is 4,300 below; in QR4 the value is 2,100 above. If your answers are too different then check out your calculations eg. your totals for each quarter should be QR1 26,000; QR2 13,000; QR3 17,000; QR4 8,500.

We can now draw our forecast graph by putting the average from QRs 2, 3 and 4 into our previous graph - QR1 figure is already in.

Remember the first 2 points should be below the trend line and the last one above.



The final step is to check that the forecast we have made looks like a continuation of the past, if it doesn't then we'll need to check our calculations and that we've plotted the graph properly.

So we can now plan accordingly - although we know the forecast won't be exact we do have grounds for believing we won't be too far out.

WE CAN NOW PREDICT THE FUTURE!

Of course we can use our forecasting methods to predict events next week, next month as well as next year so we have developed a very useful tool here.

SELF CHECK 7
Time guide
1 min

If one quarter's figures differed substantially from the forecast this is probably due to which one of the following:

a) Seasonal variation

b) Random variations

c) Change in the trend

The answer to this self check is here in the following words, so you'll need to check out your answers carefully. A single figure which is quite different from others in the data is probably due to some random variation.

Before leaving this topic of forecasting data we should mention that some trends don't follow a straight line as in our example. It's quite possible that the trend line is curved. In this case the calculations are just the same as before, but drawing the best line is not as easy as it will be curved.

SELF CHECK 8
Time guide
2 mins

Use numbers to indicate the order in which we carry out the following steps in forecasting. Start with (1) for the 1st step.

Forecast actual values * _____

Draw the trend line * _____

Plot actual forecast on graph and join points * _____

Extend the trend line to make forecast trend * _____

Find seasonal variations by measuring distance from trend line and averaging * _____

The answer to this self check is here in the following words, so you'll need to check out your answers carefully. 1 Draw the trend line; 2 extend the trend line to make forecast trend; 3 Find seasonal variations by measuring distance from trend line and averaging; 4 Plot actual forecast on graph and join points; 5 Forecast actual values. Steps 1, 4 and 5 must take place in the order shown. However, we could reverse steps 2 and 3 and measure the seasonal variations before forecasting the trend. The order I have used is the one we have used in this section of the Unit.

EXTENSION 4 page 47

If you would like to explore the area of forecasting further you are invited to take up our last extension which deals with aspects of forecasting which we haven't been able to cover in this unit.

4. Summary

We can only plan if we can forecast results.

Forecasting rests on the fact that there is a pattern in the data.

The patterns we can forecast from are:

trends

seasonal variations

But we can't forecast

random variations

A SEASONAL VARIATION is a change in data which occurs at regular times in the year

A TREND is a general upward or downward movement in data.

If data has both a TREND and a SEASONAL VARIATION then we forecast the trend first and then calculate the seasonal variations FROM the trend line - the complex pattern is then clear.

PART D PERFORMANCE CHECKS

1 End Check

Time guide 60 mins

You may review your understanding of the Unit as a whole by completing this group of questions. **DON'T GUESS THE ANSWERS** - if you're not sure, flick back into the Unit and check before responding.

If you are still unsure then put a question mark against your response before proceeding.

TRUE/FALSE

1) Graphs are generally misleading _____

2) Comparisons between data can be done on graphs using different scales _____

3) A flat-rate wage increase will give the highest percentage increase to the lowest paid _____

4) Wage differentials are eroded by percentage increases _____

5) To keep up with 5% inflation we all need a £5 p.w. pay rise _____

6) If output falls faster than employment the output per head will also fall _____

7) A trend shows a general direction of movement in data _____

8) Random variations in data cannot be forecast from past data _____

COMPLETION

Respond by completing each sentence with a suitable word or words.

9) We use graphs to give a clear _____ of movements in data.

10) Graphs which are drawn for comparison should use _____ scales.

11) _____ can be used to compare increases or decreases in figures.

12) Output per head is found by dividing output by _____.

13) Sudden unexpected variations in data are called _____ variations.

14) Forecasting must take into account any trend and any _____.

15) A trend can be represented on a graph by a _____ or curved line.

MULTIPLE CHOICE

16) Which ONE of the following is a seasonal variation:

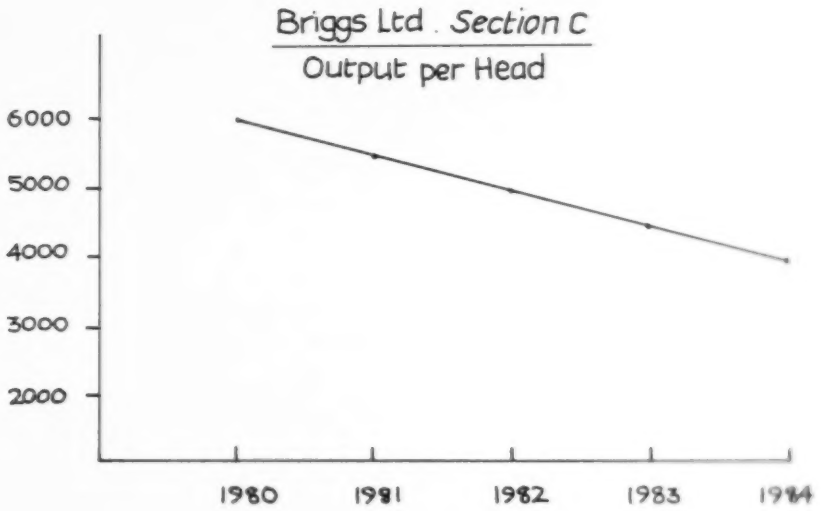
a) A fall in output due to a strike.

b) Increased unemployment in September due to school leavers being included in the figures.

c) A fall in production due to machinery breakdown.

d) High absenteeism because the local football team are playing in the cup final.

17)



Which ONE of the following conclusions could be correctly drawn from this graph?

a) The section is producing less in 1984 than in 1980.

b) There are less employed in this section in 1984 than in 1980.

c) The section is less efficient in 1984 than in 1980.

d) The section is working harder in 1984 than in 1980.

18) Which ONE of the following statements describes a trend.

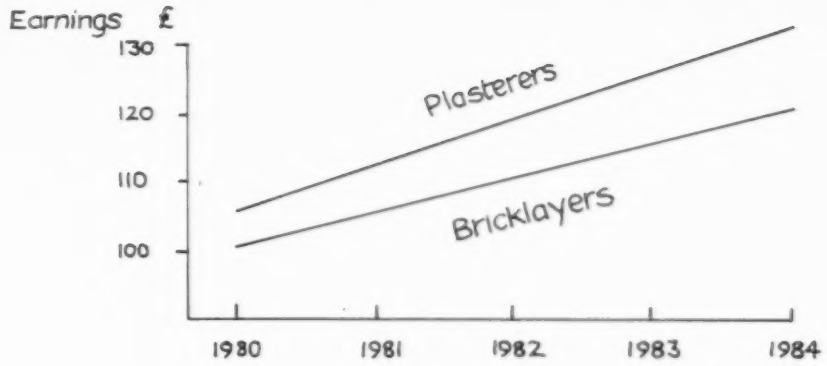
a) Sales of sunglasses have been very high lately

b) Over the last 3 years there has been a steady decline in the numbers of people smoking

c) Sales of computers are now very high

d) There has been less influenza about this winter than last winter

19)



Which ONE of the following could be correctly concluded from the graphs above.

a) Plasterers' earnings have gone up faster than bricklayers'

b) Bricklayers earned more than plasters throughout the period

c) Plasterers earned more than bricklayers throughout the period

d) Bricklayers' earnings have gone up faster than plasterers'.

END CHECK - Checkout

Audio Tape Side 2 Time guide 35 mins

The answers and explanations for these End Checks are on Side 2 of our Audio Tape. Have your responses with you as you play this tape. As you listen you can check out how well you have done and make notes as you proceed.

2 Tutor Check

Time guide 60 mins

Read through the following Case Incident then deal with the questions that follow:

Case Incident

'Daniels' is an up-to-date hairdressers and stylist for both men and women. Recently, one or two customers have complained about the way in which prices have increased. Dan, who runs the salon, feels the prices have only gone up in line with inflation and decides to check on this. He has made a record of prices for the last 3 years for 'cut and blow dry' and has looked at the annual inflation figures.

This is the data he collected.

Table of Costs of "Cut & Blow Dry" and the percentage increases from Jan 82 price with the Inflation figures in the same period:

	Cut & Blow Dry		Inflation
	£	%	%
Jan 82	6.00	-	-
Jul 82	6.06	1	3
Jan 83	6.18	2	5
Jul 83	6.40	3.5	4
Jan 84	6.75	5.5	6
Jul 84	7.17	6	7
Jan 85	7.67	7	7.5

Now to the questions:

1 Draw a graph of both these percentages on a sheet of graph paper - leave room at the right-hand end of the page for forecasting.

2 a What is the annual rate of inflation?

b What is the annual rate of increase in "Cut & Blow Dry" cost?

(Use the "trend" lines to answer both these questions)

3 Were the customers right in their complaint to Dan about his prices?

4 What would the price of Cut & Blow Dry have been in Jan 85 had the Jan 82 price risen in line with inflation. Show your answer on the graph.

Send to tutor

Now get your answers to your study tutor either by post or handing it over personally. You will receive your tutor's assessment and comment back through the post as soon as can be managed.

3 Work Based Project

Since each person using this unit will be involved in a different type of work, you have a choice for this exercise you'll probably be able to find suitable data for one of the exercises. So do ONE of the following projects.

Project A

Select some data which you receive or compile in your section. Suitable examples would be output from machines, output for the section, total hours worked, employee lateness or absenteeism. However, these are just examples - some data specific to your job would be ideal.

Get a record of the data going back 3 or 4 years if possible - if not go back as far as you can. Once you have got your data, draw a graph of the data, but leave room at the right-hand side of your paper for a forecast. Now use the procedure we used in Part C to produce a graph of future data. Do this step by step as we did earlier and make some short but careful notes as you proceed.

OR

Project B

This is an exercise in comparing data. Collect TWO or more sets of data which are directly comparable. These could be for instance, wage rates or earnings for TWO or more groups of staff, output from different machines, or different sections, numbers of different products made or anything else which is relevant to your job. Collect the figures for a period of time - if the data is annual then a number of years, or if monthly data a number of months. You could equally use weekly or daily data if it is appropriate.

Compare the sets of data using a graph and make a list of the main features of the data, as shown on the graph. Make sure that the graph is well labelled so that no confusion can arise in comparing the lines. You recall we did an exercise like this in Part B.

Send to tutor

Now get your answers to your study tutor either by post or handing it over personally. You will receive your tutor's assessment and comment back through the post as soon as can be managed.

PART E UNIT REVIEW

1 Return to objectives

Having completed your work on this unit, let's review how you feel about each of our four opening objectives. I'll repeat them here and add comment:

Our first objective was

You will be better able to:

* IDENTIFY THE MOST IMPORTANT FEATURES IN A SET OF FIGURES

You'll probably recall that when we put a set of figures into a graph then any patterns present become much clearer. The visual impact that graphs give help us to read and understand the data. Now that you are better able to plot and read graphs you have met this objective.

Now to our second objective. You will be better able to:

* MAKE USEFUL COMPARISONS BETWEEN TWO OR MORE SETS OF FIGURES

We spent considerable time looking at the way graphs can be made to mislead. The way the graphs are labelled, the way the values are entered on the axis and the kind of data displayed can all contribute to false comparisons being made between graphs. Now that you more clearly understand these distortions means you have met this objective.

Now to our third objective. You will be better able to:

* IDENTIFY TRENDS AND SEASONAL VARIATIONS IN GRAPHS

We recall that trends are general movements in data either upward or downward. We appreciate that seasonal variations take place at regular times each year. Now you are able to identify these variations in a graph then you have met this objective.

Now to our fourth objective. You will be better able to:

* MAKE FORECASTS OF THE FUTURE BY USING GRAPHS

We took what we could call the worst case, where the data had a trend and a seasonal variation in it. Even in this circumstance you were able to handle the graph well enough to project the graph into next year. Being able to do this means that you have met this objective.

By meeting each of these objectives you will be in a better position to make sense of data by both plotting and reading graphs. This will help you understand the data well enough to be able to explain the data and plan on the basis of the data - both very useful skills.

I hope that the work you have done was enjoyable and useful enough to encourage you to continue in your studies.

2 Extensions

We recommend that you take up as many of these extensions as you can. They will further increase your understanding and interest. You will also be able to check out a number of the ideas mentioned in the Unit. The extra time and effort will prove very worthwhile.

EXTENSION 1

Book: The Choice unit - 43: Descriptive Statistics

Author: Y M Carlisle

Publisher: Northern Regional Management Centre

EXTENSION 2

Book: The Choice unit - 30: Looking at Figures

Author: L Carr

Publisher: Northern Regional Management Centre

EXTENSION 3

Book: The Choice Unit - 73: Wage Payment Systems

Author: Y M Carlisle

Publisher: Northern Regional Management Centre

PART A - The Aims and Determination of Payment

EXTENSION 4

Book: Mastering Statistics

Author: T S Harregan

Publisher: Macmillan Education

CHAPTER 14 - Trends and Forecasting

These extension opportunities can all be taken up via your Resource Centre.

They will either have the materials or will arrange that you have access to the materials. However it may be more convenient to check out the materials with your Personnel or Training people at work - they may well give you access. There are other good reasons for approaching your own people, for example they will become aware of your interest and you can involve them in your development.

3 References

REFERENCE 1 Book: Using Statistics in Business 1

Author: Peter Clark

Publisher: Pan Breakthrough series

CHAPTER 9 - Representing Data by Graphs

REFERENCE 2 Book: Using Statistics in Business 2

Author: Peter Clark

Publisher: Pan Breakthrough series

CHAPTER 7 - Lies, Damned Lies and Statistics

REFERENCE 3 Book: Using Statistics in Business 2

Author: Peter Clark

Publisher: Pan Breakthrough Series

REFERENCE 4 Book: Supervisory Studies

Author: P W Betts

Publisher: Macdonald L Evans

These references may be available at your Support Centre. They may either have the materials or could arrange that you get access to the materials. However it may be more convenient to check out the materials with your Personnel or Training people at work - they may well give you access. There are other good reasons for approaching your own people, for example they will become aware of your interest and you can involve them in your development.

If you do wish to make use of these references then don't think that you must read right through. Just dip into them for a slightly wider treatment of the topic raised by the unit.

I should warn that the language and style of the writing is often difficult to cope with. So don't struggle with it too much. Do what I do when in difficulty, put the book back on the shelf and find a better one!

THE CHOICE SERIES

PRINCIPLES AND PRACTICE OF SUPERVISION

11 Needs and Rewards
12 Enriching Work
13 Workteams
14 Team Leading
15 Leading Change
16 Organisation Systems
17 Supervising in the System
18 Supervising with Authority
19 Workplace Control
20 Taking Decisions

TECHNICAL ASPECTS OF SUPERVISION

30 Looking at Figures
31 Basic Planning
32 Using Figures
33 Work and Method Study
34 Easy Statistics
35 Quality Control
36 Plant Capability
37 Controlling Output
38 Value Engineering
39 Quality Circles
40 Computers
41 Stores Control
42 Managing Time
43 Descriptive Statistics

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61 Speaking Skills
62 Writing Skills
63 Communication Systems
64 Orders and Instructions

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71 Control via Budgets
72 Cost Reduction
73 Wage Payment Systems
74 The National Economy

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81 Training Sessions
82 Discipline and the Law
83 Industrial Relations
84 Health and Safety
85 Industrial Relations in Action
86 Equality at Work
87 Hiring People
88 Supervising and the Law
89 Industrial Relations and the Law